Multiple SiPM readout for EIC calorimeter prototypes, couple of questions for discussion today.

Not need to answer these now, probably, not critical for coming test run but at some point we'll need to decide how to proceed.

How to select (group) sensors for a single tower?

(gain, PDE, temperature dependence, dark noise rate, etc.)

(gain, and T dependence adjusted/compensated at FEE)

b) PDE, what actually do we measure with the test setup?

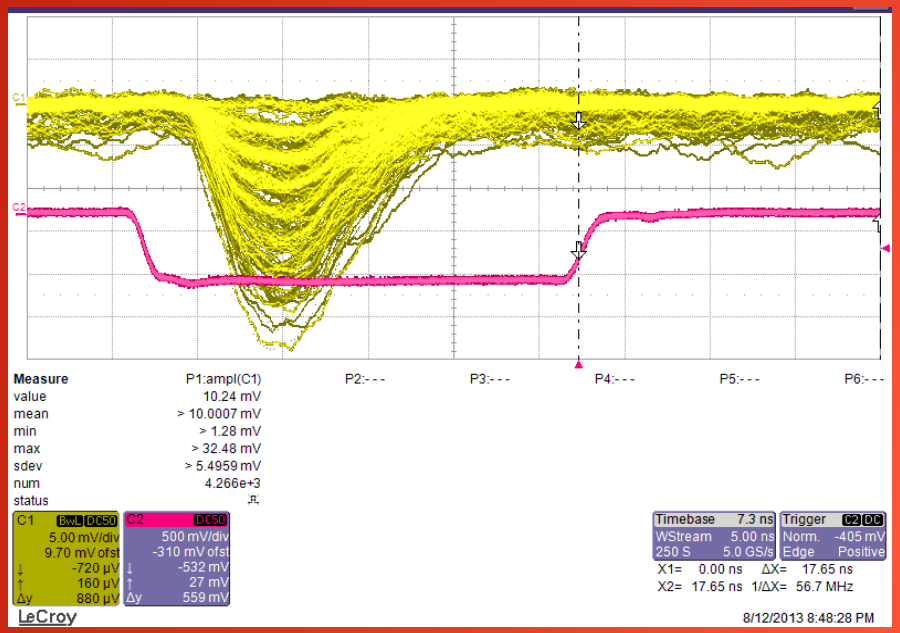
c) Choice of optimal bias voltage?

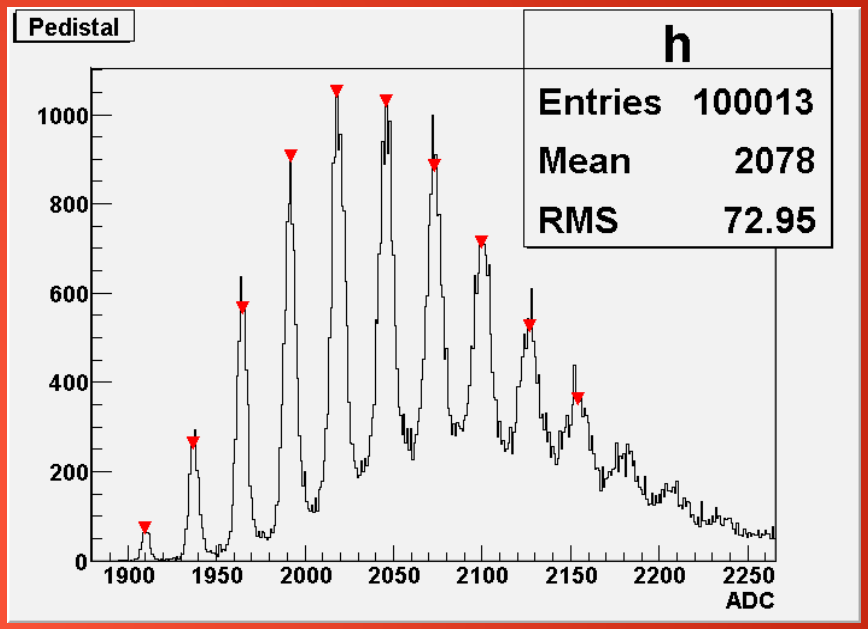
Adam Lamson (RPI) summer student, supported from EIC R&D funds will tell you about his ongoing SiPM characterization research project here at UCLA.

08/15/2013

O.Tsai (UCLA)

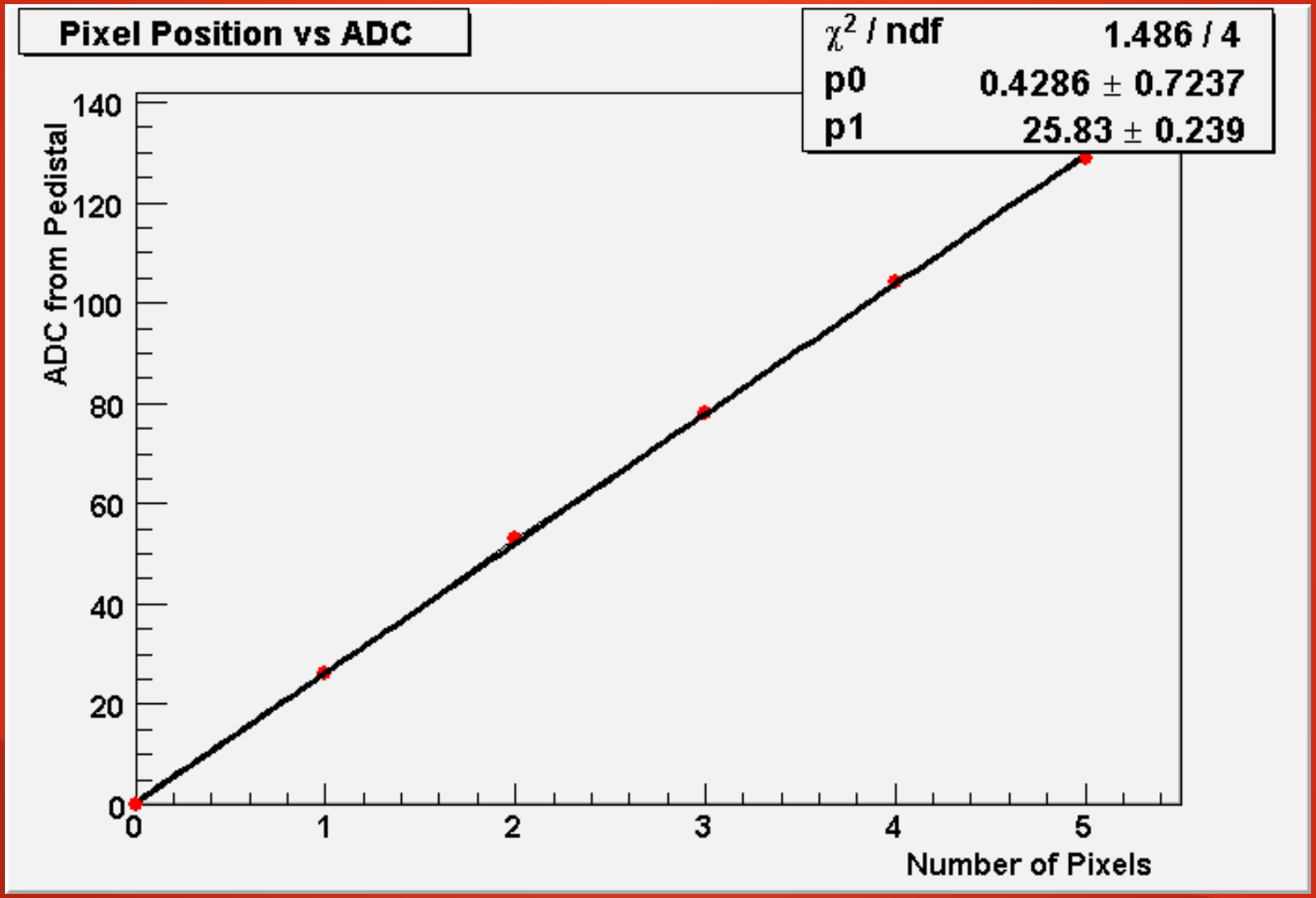
SiPM Spectra





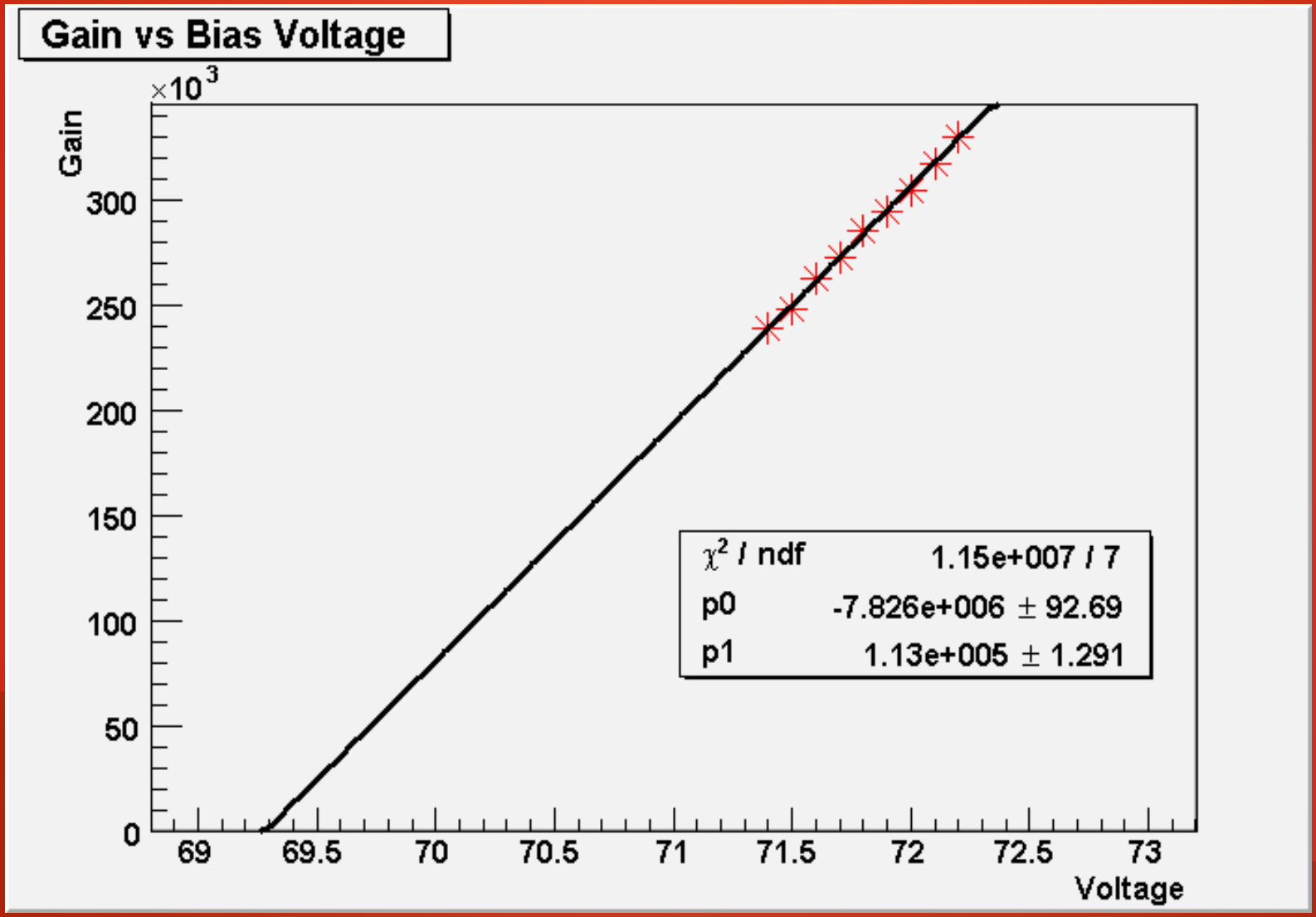
	GLUEX sensors mass testing	Our Sensors
Gate	~120ns	20ns
Breakdown Voltage	~70.4 V	~ 69.3V
Gain	5*10^5 at 1V above breakdown	Same at 3V above breakdown

Determining Gain



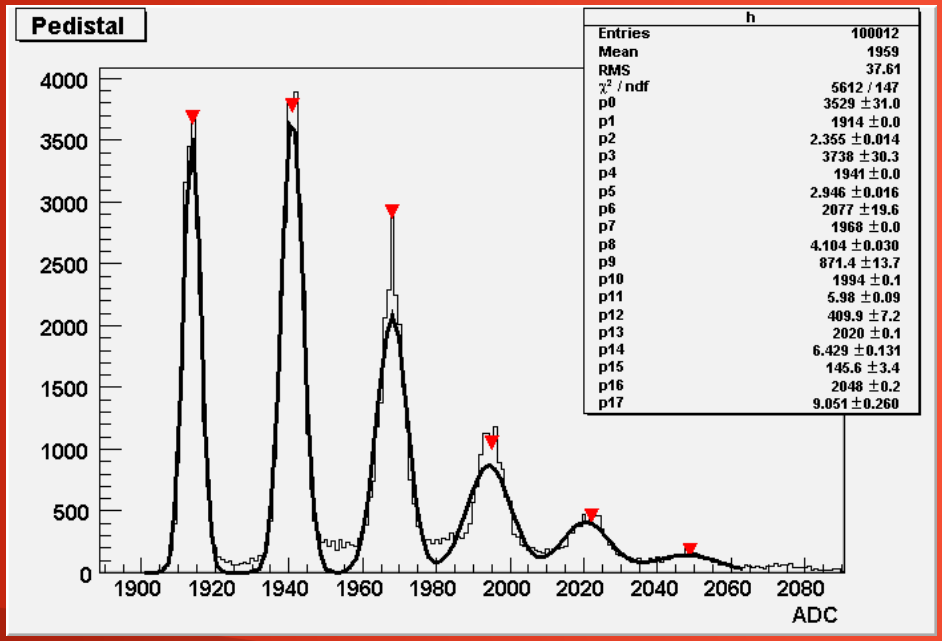
Gain = Slope of Graph * Coulombs per ADC / Elementary Charge

Gain Vs Bias and Breakdown Voltage



Breakdown voltage = 69.3 V

PDE Calculation



Fitted data but notice inaccuracies and noise.

How? Calculate Mean number of Photons

Techniques:

- <N> = Mean/(ADC per Pixel)
- Poisson Distribution using probability of no photon

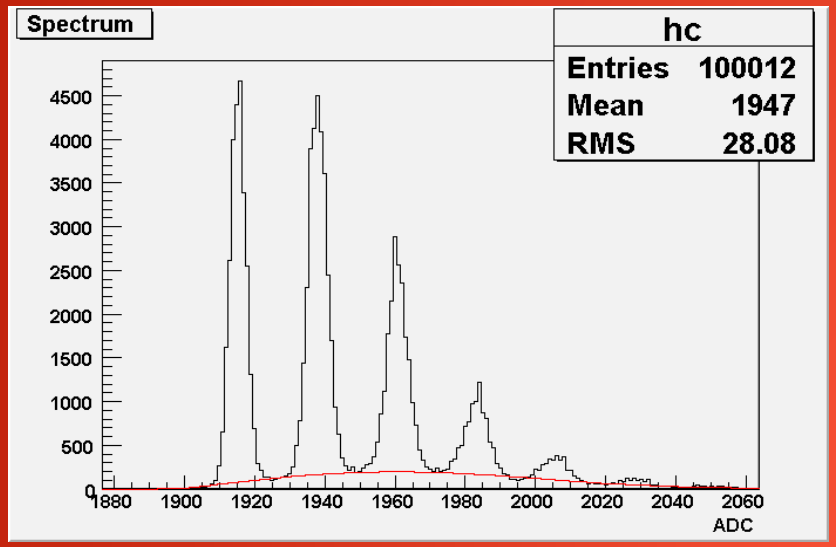
  <N> = -ln(Prob(0))
- Gluex Method* (Convolution of two Poisson Distributions)

  mean = <N> * (1 +OC)

  var = <N> * (1+3OC+OC^2)

*O. Soto, et al., Nuclear Instruments & Methods in Physics Research A (2013), http://dx.doi.org/10.1016/j.nima.2013.06.071i

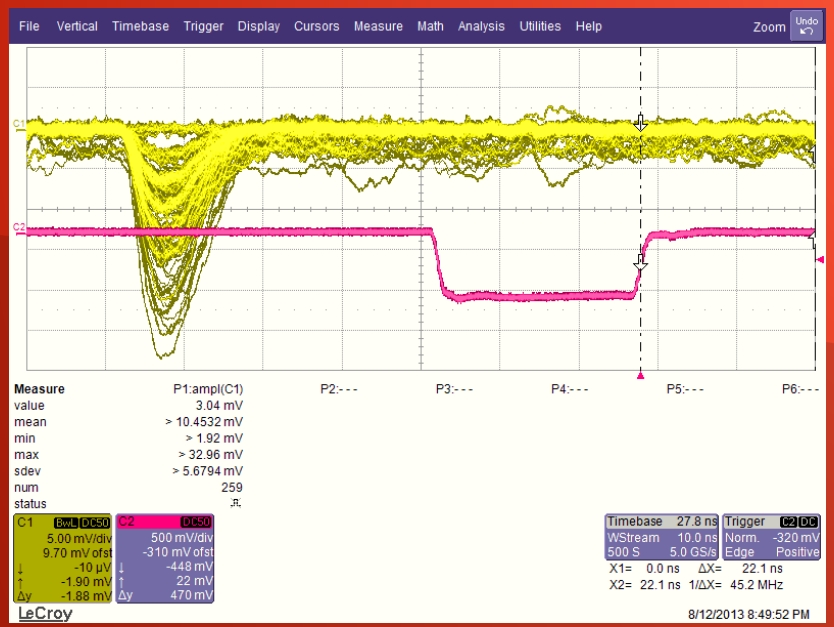
Background Determination



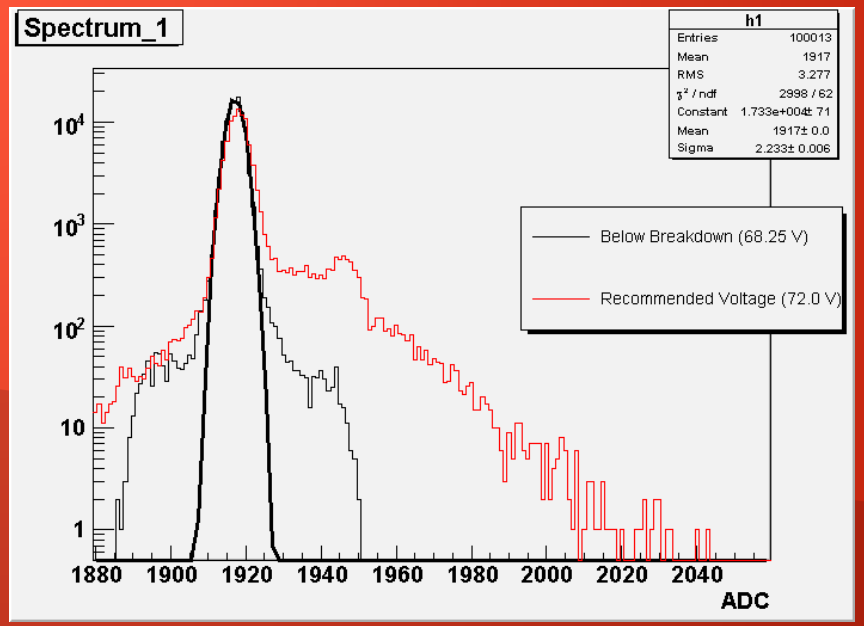
Underlying noise function

Possible Backgrounds

- Dark Noise
- Optical Crosstalk (OC)
- Afterpulsing

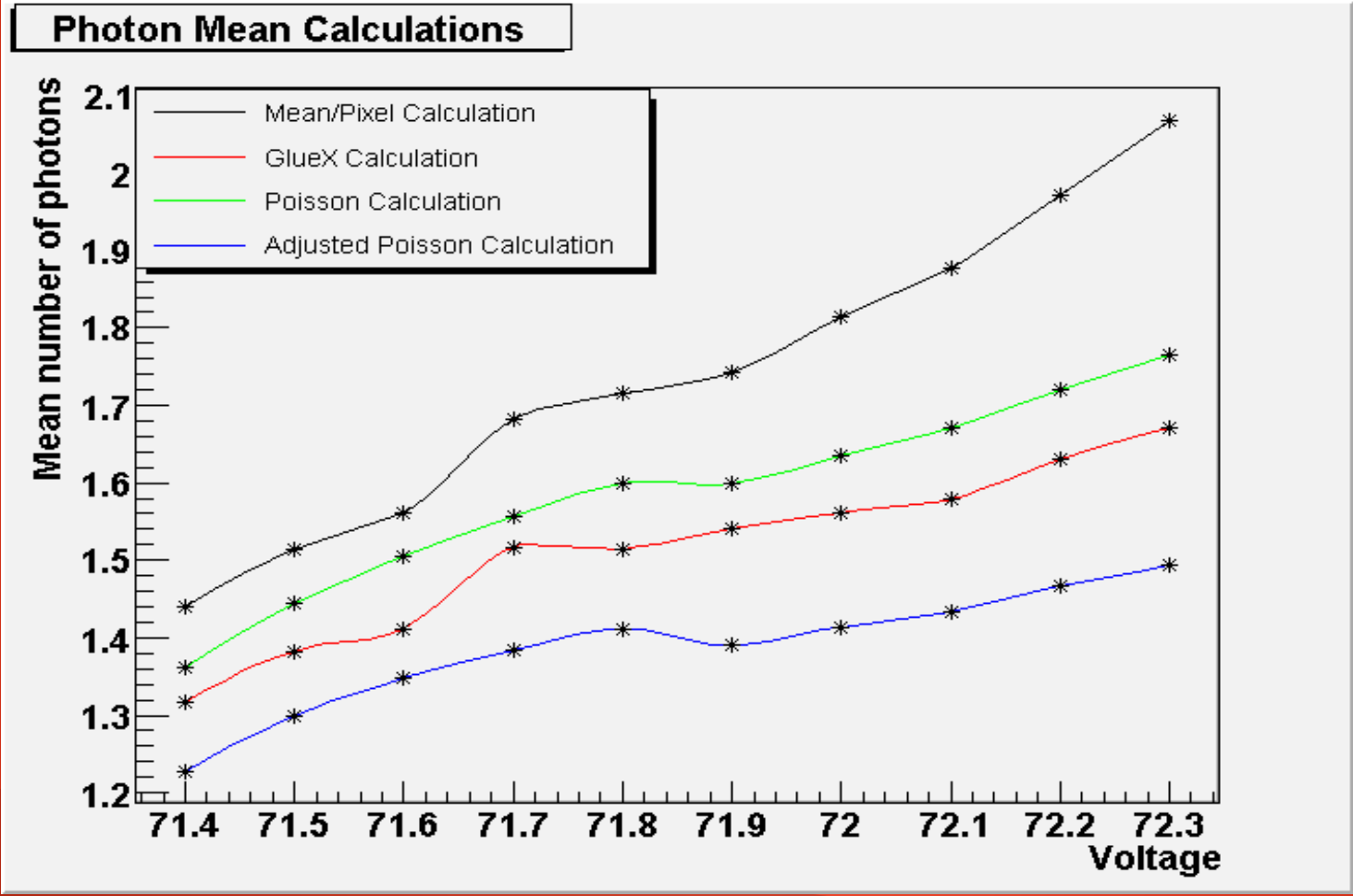


Pulse set before gate to determine dark noise



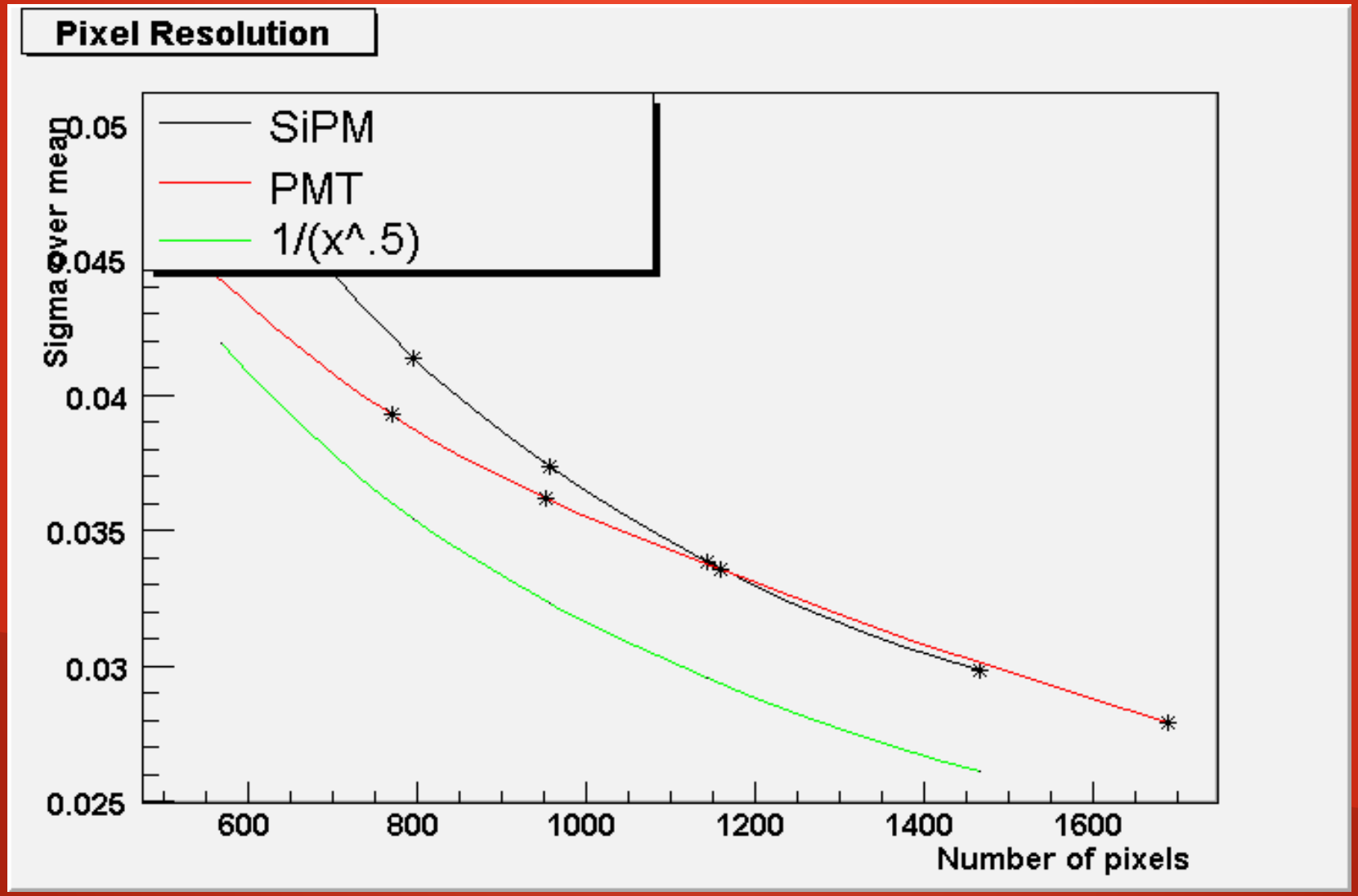
Dark noise comparison above and below breakdown voltage

PDE Comparisons



Adjusted Probability of Zero = Probability of zero / (Probability of zero when pulse was outside gate)

Toward Excess Noise Factor Measurement



To Do List

1. Measure excess noise factor for MPPC vs bias voltage (question #3)
2. Try to estimate O.C. from dark noise.
3. Dark noise vs bias voltage.
4. May be look at afterpulses if time permit.